

in this summary. In his opinion both the Bay-breasted and the Black-poll Warblers are common transients in Tennessee. However, in his collection of skins, the only one in the State, there is but one Black-poll Warbler, a male taken May 15, 1916. He apparently has never taken the bird in the fall, so until definitely proven otherwise this species must be considered a spring migrant only in Tennessee.

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## RELATIONSHIPS BETWEEN DIET AND EXTENT OF PARASITISM IN BOB-WHITE QUAIL

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During the course of a two-year food and parasite survey of Missouri Bob-White Quail (*Colinus virginianus virginianus* Linn.) considerable data was amassed. To a large extent the information secured merely corroborated that obtained previously by other investigators (Errington, '31-'34, Stoddard, '31). In addition, however, the data brought out some new side-lights and interesting implications heretofore untouched, or at least very little emphasized in quail investigations, and indicating a relationship between diet and parasitism in the bob-whites.

The food-list of the bob-white is a very long one; crop analyses (Stoddard, '31) show that practically any accessible seed may be eaten, together with a long list of fruits. Naturally, not all these seeds are eaten by preference nor do they all contain available nourishment. In Missouri (Nagel, '33) the kinds of foods quail eat by preference, and which afford the proper elements of nutrition, are as follows:

Cultivated grains (corn, sorghum cane, millet, Kaffir corn, soy beans).

Ragweed (*Ambrosiaceae*).

Legumes (*Leguminaceae*) (Wild beans, peas, beggarweed).

Buckwheat (*Polygonaceae*) (Smart-weed, Knotgrass).

Senna (*Cassiaceae*) (Partridge-pea).

Grasses (*Graminae*).

This is not, of course, a complete list. It includes the foods most commonly eaten in the order of nutritional value and of preference.<sup>1</sup>

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<sup>1</sup>It is a question whether "preference" might not be due largely to quantity and accessibility.

During the year 1932-1933 when the investigation was begun, large amounts of all the above foods were available in the areas studied. It had been a good year for growth and an open winter obtained. No evidences of food shortage or of starvation were noted during the six months (October, '32-March, '33) survey. The hot, dry summer following, however, severely curtailed the supply of natural foods for the succeeding winter. A similar study (October, '33-March, '34) essentially over the same territory covered in the previous year showed entirely different results with regard to amount and quality of food available, and the extent of parasitism obtaining. Since the data are too cumbersome to present as a whole, the significant and related factors are included in tabular form.

TABLE 1. Comparison of Diet and Parasitism in Bob-White During a Two-Year Survey. Under Different Conditions of Diet.

VARIANT CONDITIONS	1932-33	1933-34
Average amount of food in crop.....	8.4 gm.	5.2 gm.
Percentage of cultivated grains.....	55%	23.7%
Percentage corn in total.....	27%	23.7%
Percentage Sorghum Cane.....	28%	00
Percentage parasitized birds.....	8.7%	61.5%
Corn-eating birds parasitized.....	75%	38%
Cane-eating birds parasitized.....	00	00

The average quail density on the areas studied during the first year was about one bird per four acres. The second year, it had been reduced to about one bird per ten acres. Since forty-two birds were examined the first year, and only twenty-six the second (about the same percentage of population represented by the kill) the increase in parasitism was probably more severe than the data indicate.

INTERPRETING THE DATA: Comparison of the data for two years shows a great increase in parasitism from one season to the next. Correspondingly, there is a decrease in the average crop-content of the specimens. The percentage of cultivated grains eaten has decreased by approximately one-half—a glance at the data shows that the difference is largely due to the absence of cane during the second year. From these comparisons the following points are suggested:

- (1) The increase in parasitism noted during the second year may be due to the decrease in *amount* of food.
- (2) The increase in parasitism may be due to a change in the *quality* of the food.

The writer has data showing that there is apparently no significant connection between amount of food present in the crop and pres-

ence or absence of parasites in the specimen. That is, a bob-white with a full crop is as likely to show parasitism as one with crop and stomach<sup>2</sup> half empty. Within the limitations of the data, then, the effects of a decrease in food *amount* are not held responsible for the increased percentage of parasitism.

Since all other conditions of environment were held as nearly equal as possible, the only other variants noted are those of (a) decrease in amount of cultivated grains used as food, and (b) a relatively milder, drier winter during 1933-34. It is difficult to see how the latter condition could affect the percentage of parasitism; moreover, there are no data available to prove the case either way. We are left to deal, then, with the variation in amount of cultivated grains in the diet.

Reference to the table will show that these grains consisted during the first year of corn and sorghum cane in almost equal proportions. During the second year, corn alone made up this part of the diet. The percentage of corn eaten was approximately the same during both years, and in each season birds eating this grain included some that were parasitized. Note the difference in the case of cane; during neither year were birds eating sorghum cane parasitized. Further, the cane occurred on one area (Nagel, '33) only during the first year, and on none during the second. Birds taken from this area during 1932-33 were found to contain cane and no parasites; birds taken from this area in 1933-34 were found to contain parasites and no cane. In all other respects, the area remained the same.

CONCLUSIONS: From the data discussed above, and in the absence of information to the contrary, we may tentatively conclude that the presence of sorghum cane in the diet of Bob-White Quail has a restraining effect on parasitism.

#### BIBLIOGRAPHY

- Nagel, Werner O. 1933a. "Parasites of Missouri Bob-white." Progress Report.  
———. 1933b. "Food of Missouri Quail." Progress Report.  
———. 1934a. "Missouri Quail Investigation." Progress Report.  
Stoddard, H. L. 1931. "The Bob-white Quail." Scribners.

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<sup>2</sup>"Crop-contents" includes contents of crop and stomach both.